MAR 8 1911

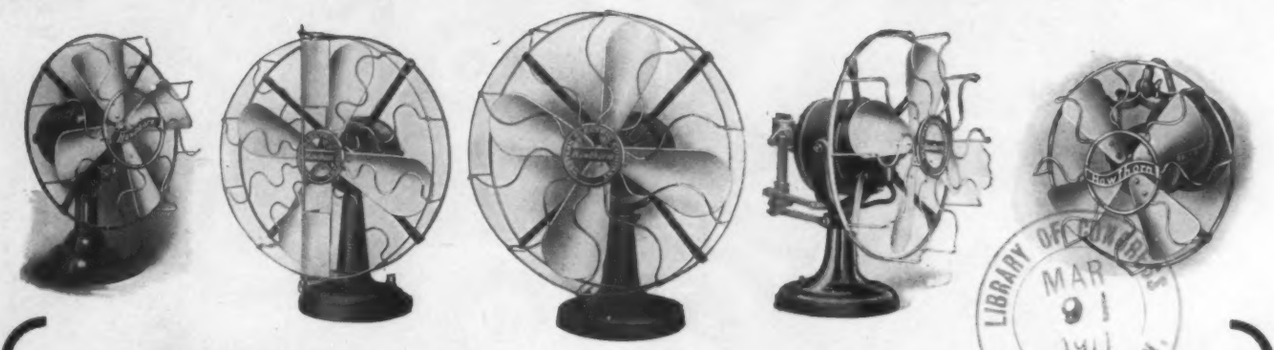
JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second-class matter May 7, 1906 at the Post Office at San Francisco Cal., under the Act of Congress March 3, 1879

VOL. XXVI No. 9 | SAN FRANCISCO, MARCH 4, 1911 | PER COPY, 25 CENTS



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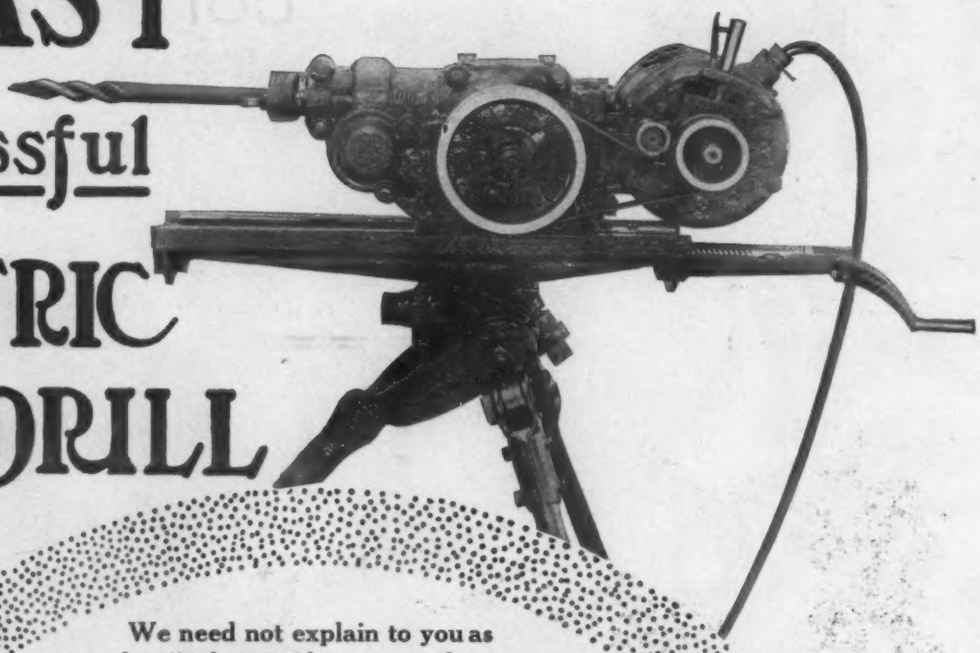

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JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXVI | SAN FRANCISCO, MARCH 4, 1911 | NUMBER 9

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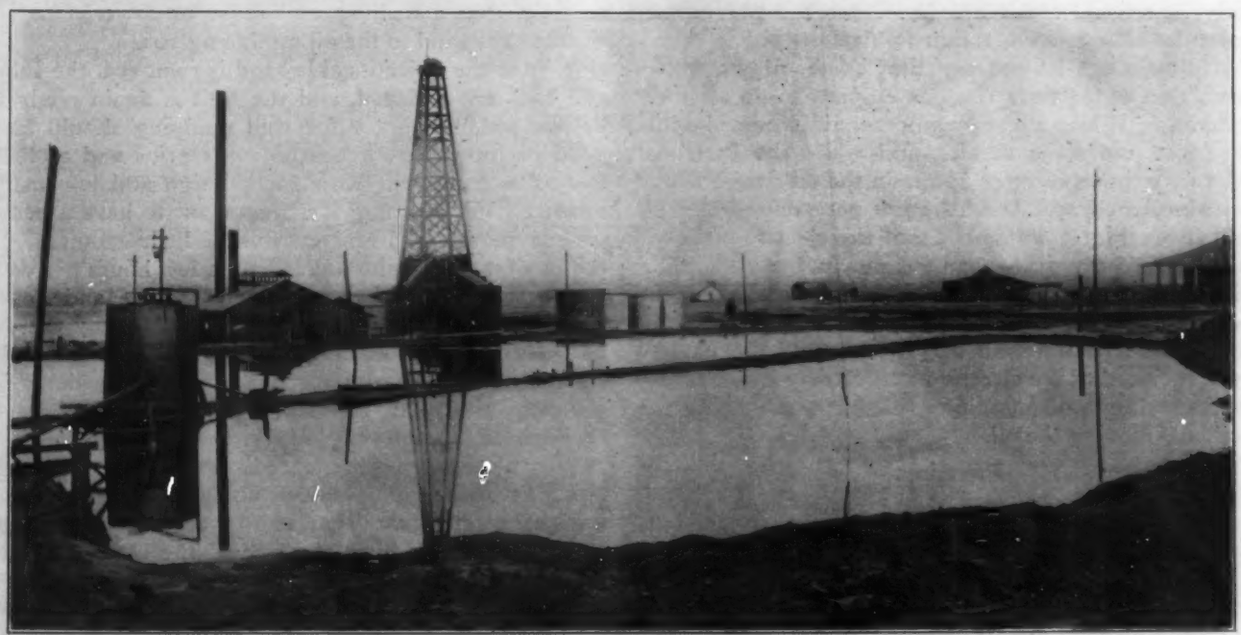
INDUSTRIAL APPLICATION OF THE ELECTRIC MOTOR

The February discussion of the San Francisco Section of the American Institute of Electrical Engineers was devoted to the adoption of electric drive in a number of industries hitherto employing some other forms of power. All these industries were well established before the recent developments in electric motors, and their requirements were being well met by the agents already in use. Particularly was this the case in pumping oil, in drilling rock and in city hauling. All these things can now be done better with electricity.

Recent extensions of transmission lines have placed electric power within reach of many oil fields, mines and towns formerly isolated from this advantage. Electrical manufacturers have made a close study of the problems to be put and have developed special types of apparatus to successfully perform the required duties. Electric power is shown to be more economical and more convenient and is consequently gradually displacing its competitors.

The various papers presented at this meeting are printed in the pages following. In each case the author states the difficulties to be overcome and shows how the electric motor has been adapted to each kind of work. Electricity is not claimed to be a panacea for industrial troubles but may be profitably applied in many instances where it is found advisable to discard other apparatus in order to install electric drive.



Typical Steam Pumping Rig in California Oil Fields

The industries treated are of especial interest to the Pacific Coast, similar papers in Eastern sections being more concerned with electric power in the factory. One industry, that of irrigation, was unavoidably omitted, it being among the most important new users of electric power. On the whole this symposium is an admirable presentation of the manner in which local conditions have been improved by electric power. The papers are printed in the order in which they were presented at the meeting. In several cases considerable data was preliminarily published in this journal of Feb. 18, 1911.

THE ELECTRIC MOTOR IN OIL WELL SERVICE.

BY W. F. LAMME.

In certain Eastern oil fields the electric motor has been in use for several years, but in California only recently have serious efforts been made to electrically operate oil wells. Since the problem involves a wide distribution over much territory the distributing system must be alternating current, and the induction motor is the only available type fitting the case.

By the use of alternating current, at say, 11,000 volts, three-phase, the distribution losses are reduced to a minimum, whereas the old method of steam distribution is very wasteful, even with the care taken to cover the steam pipes with heat confining covers and to bury the pipes in the ground.

But before electric drive can be adopted in the oil fields an ample supply of electricity must be available to the user and it must be offered at a reasonable rate. During the past year the San Joaquin Light & Power Company have constructed distributing lines through the oil fields at Coalinga, distributing at 11,000 volts four wire star, using 6600 volt distributing transformers, and have placed electric power at the door of the operator, offering it at a reasonable rate.

This makes a condition where the operator has now only to convince himself that the work can be done with the electric motor at a cost that will pay him to make the change from steam to electricity.

In passing, let me say that some oil properties furnish enough gas to run gas engines to do all their pumping. While a gas engine requires considerable attention, and some repairs, and while the first cost is large, yet this form of power in the oil fields, where available, is cheap. We have not yet secured enough data to warrant a statement that the electric power is cheaper on the average than gas power, but comparing with steam power, the data is certainly against the steam.

In order that we all may understand the kind of work required of the electric motor, let us divide it into the four classes of pumping, cleaning and drilling the well, and moving the oil.

Pumping.

An oil well consists first of an outer pipe ranging in size from 16 to 6 in. called the casing, which is put in while the well is being drilled. Inside this casing is placed a second string of pipe ranging in diameter from 2 to 3 in., called the tubing, which forms the walls or stock of the pump. Inside the tubing is a series of rods screwed together, to the lower end of which is attached a sucker with a ball valve, to catch and raise the oil in the tubing.

As there is only one rod and one lift the load is fluctuating, particularly in the case of a deep well. There is no objection to this fluctuating load except that it increases the copper losses in the motor, thus lessening the possible output. Since copper losses increase in oil well work, a motor with small copper losses is best.

When pumping by steam the engine is run direct upon the throttle without a governor, and so the fluctuation in the stroke is much greater than with the motor (unless the motor is run with much resistance in its secondary circuit). Some oil operators claim this is a good thing, for they say it lessens the strain on the pump rod, and so lessens breaks in this rod. However, this view is not being supported in practice, the motor and gas engine, both of which give a more uniform stroke, do not produce any more broken rods, and to date there have been less breaks. Undoubtedly the more regular movement raises more oil, and this is an argument in favor of a more uniform drive.

The number of strokes per minute in pumping an oil well varies between 16 and 26, depending upon the kind of oil, whether heavy or light, the length of the stroke, the strength of the rods and the tendency to sand.

Cleaning.

The sanding or clogging of a well explains the necessity of cleaning it. Oil is found in loose beds of sand in the earth, and this sand and oil are frequently under considerable pressure, especially when a well is new. The sand is inclined to clog the lower end of the pump stock, and frequently it so stops the flow of the oil into the pump, as to necessitate cleaning away the sand. This is done by raising all the pump rods and tubes (in sections of about 60 feet each) and then introducing a bailer to remove the clogging sand. The bailer is a piece of pipe closed at the lower end by a ball valve, having a projection to open the valve when bailer strikes the bottom. Sometimes this sand gets so tight that a drilling tool must be lowered to cut through the sand to the oil producing strata.

After the objectionable sand is removed, the tubes and rods are replaced, and the well is again ready to be pumped. A motor for well pumping should have good performance for continuous service and as little loss as is consistent with good design and low maintenance. For cleaning it is important to have a heavy pulling motor, and efficiency is of little moment, for the process of cleaning takes only a few hours per well. These two features of good performance and heavy pull, are at present combined in one motor, by the use of a three pole, double throw switch, throwing the stator windings in star for pumping, and in delta for cleaning, the delta connection giving approximately three times the pull that the star connection gives.

In cleaning, higher speeds are required than in pumping, these higher speeds being secured by changing pulleys to give from 1½ to 2½ times pumping speed, depending upon the size of the motor and the nature of the work. The smaller the pulley, the longer the time required to clean a well, and the smaller need be the motor. This question of speed and time for cleaning is still a disputed point, that is, how large should the motor for cleaning be compared to pumping requirements.

This combination of a cleaning and pumping motor in one, has not given the best results for either service, as cleaning requires a rugged motor with resistance and a controller large enough to do the heavy work, which is a handicap in pumping, and makes the equipment expensive, while the motor for cleaning is light for the work. But as it stands, the equipment is well fitted to a condition where cleaning is done infrequently, say once in two weeks or a month.

In oil well work to clean the well is at present found to be necessary. But attempts are being made to

introduce screens into the well, which it is claimed will keep back the sand and so prevent sanding. Should this plan prove a success then the cleaning feature will become a secondary matter, and the pumping equipment can then be greatly cheapened.

Drilling.

In the process of drilling an oil well, a cutting and hammering tool of considerable weight is drawn up and dropped much as in a pile driver, except that with the drilling outfit the tool is at the end of a line which springs, the action being something like that of a weight at the end of a spiral spring. If you take hold of the other end of the spiral with the weight downward, and move it up and down, striking the ground with the weight, the heaviest blow will be made at a certain speed, the downward fall of the weight must not be retarded by the spring, and the spring must catch up the weight as soon as the weight has struck the blow, otherwise an improper reaction takes place and time will be lost.

The condition illustrated by the spring and weight is the one sought in drilling an oil well, and so the motion given by the engine or motor must vary to accomplish this effect. At first thought the condition named may seem easy. But when we consider the weight of a long steel rope, which is the spring, it is noted the condition is continually changing, which together with the different kinds of ground drilled, makes quite a problem, for it is always the aim to maintain a maximum rate of digging.

In the process of drilling, water is introduced into the hole, which aids the cutting and facilitates the removal of the waste. After a certain amount of drilling is done, the drilling tool is drawn up, and the bailer is lowered into the hole, filled, brought to the top, emptied, then lowered several times until the hole is clean and ready for the drilling tool again.

In this process of bailing, high speeds are essential, especially where the well is deep, otherwise much time will be lost. In the case of pumping, time can be given to change pulleys, but in the case of drilling, this is not permitted, so the motor has to furnish the faster speed.

Mr. Clark, engineer for the South Penn oil fields of West Virginia, made a design of motor for that field, as follows: The motor has two stators on a single base, one stator stationary, the other arranged to be moved about the shaft by means of a worm gear.

The rotor is in two parts, solid on one shaft, and with one winding extending through both parts, it is wound squirrel cage with a short-circuiting ring at each outer end. Both parts are arranged to give double speed.

The worm gear adjustment gives nice ranges of speed for drilling, and the double speed feature is used where high speed is needed, as in bailing. This motor has also the star delta arrangement, so enormous pulls may be exerted when necessary, such as when the tool sticks or a string of casing becomes tight in the well. Excellent results are reported in its use.

In oil well drilling experiments are being made with a circulating pump, or circulator, which forces water down the casing, and this water raises the waste on the outside of the casing. This may be so perfected that bailing will no longer be needed, and so the high speed feature on the drilling motor may be eliminated. This will simplify the motor and make it less costly.

The rotary drilling rig is coming into use, and is easy to drive by the use of a motor, for no special speed or different feature from the standard motor will be necessary, and it is possible constant speed will be all that is required. If so, then the drilling problem, so far as the motor is concerned, will be easy. The rotary drill is simply a turning tool which bores itself through the ground.

Moving the Oil.

To complete the circle, and do away with steam drive entirely, there should be some additional means of moving the oil from the sump to the storage or the pipe line. Part of the movement is now done with a tail pump or a plunger pump, on the opposite end of the beam from the oil pump. This does well, except in the case of reservoirs or sumps beyond the reach of the tail pump. At present such wells use a sump pump or separate reciprocating steam pump, but to operate this a steam line has to be run, and there is considerable expense in its installation. Some sort of simple high speed rotary pump devised to pump oil against a head of about 100 lb. per square inch, should prove an acceptable substitute.

This work of moving the oil by electric drive has not yet been taken up, and in doing so, the engineer must not forget that a little rise in temperature, a little heat in the oil, greatly facilitates its movement, hence the apparent necessity of retaining steam drive for sump pumping.

But this small quantity of heat can be supplied by electric coils, or by a small portable boiler set beside the reservoir and using but a few gallons of oil per day.

In summarizing it is seen that considerable progress has already been made in adopting the electric motor to oil well work, though an oil well pump, so far as power is concerned, is an inefficient affair. The electric motor is a high speed machine, the well pump a slow speed machine, and the link between the motor and the pump is not efficient, frequently half the energy applied being wasted before the pump is reached. To date the application of the motor is made in one of two ways:

1st. The belt and counter shaft plan, in which the motor is belted to a counter-shaft and the counter-shaft to the main drive, a large wooden wheel supported on two wooden posts which operates a walking beam, which in turn operates the pump.

2d. The motor itself has a counter-shaft, which counter-shaft is driven by gear and pinion, and in turn is belted to the main drive as in the first instance.

In both instances a counter shaft is necessary, as well as gears in one instance, also the walking beam and main drive are far from an efficient means of reaching the pump. Tests have shown that some pump rigs waste as much as 50 cents of current per day, to make up the loss between motor and pump, that is $15 per month, where it looks as if $5 should cover the loss. There is great need for a more direct means of getting from the motor to the well, and at the same time permit the use of a higher speed, therefore a more efficient motor.

MOTORS FOR DRILLING AND PUMPING IN OIL FIELDS.

BY M. RHINE.

While it is true that motors have been in use for some time for both pumping and drilling in the South Penn oil fields, it has only been within the last few months that it has been actively considered for the California fields. While the electric manufacturing companies have realized that this presented a big field to be developed, they were unable to do anything owing to the fact that there was no electric transmission line into the oil fields that could furnish power at reasonable rates.

Within the last year the Pacific Light & Power Company of Los Angeles has looked into the power conditions of the oil fields and come to the conclusion that if the electrical manufacturing companies could build a satisfactory motor, the oil fields would be a large market for the sale of electric power. With this in mind, the Pacific Light & Power Company carried on a series of tests in the Sherman fields at Los Angeles and it was proven to them conclusively that the electric motors were satisfactory in every respect. At present the transmission lines are in the Coalinga fields and lines are now being extended into Moron, Kern River, Midway and McKittrick fields.

After a well has been drilled and cased, a 3-in. tubing is inserted, which runs to the bottom of the well, and at the bottom of this tubing is placed the pump barrel, or pump proper, and the well is then ready for production. Usually there is installed a battery of boilers at a central point and steam feeds are run to the various steam engines. The steam engine is belted to the large band wheel, the band wheel is then connected to the walking beam through a crank, the walking beam in turn being connected to the pump rods.

The number of strokes per minute is varied from day to day, the minimum being about 16, and the maximum about 30 per minute, depending upon the conditions of the well. As an example—providing they should be pumping at 25 strokes, it perhaps is pumping too much sand, and it is then necessary to reduce the number of strokes to say 23 or 22, whatever the case may be. This, of course, is only true in the new fields. This, therefore necessitates the use of the variable speed induction motor. It is also very essential that the upward stroke of the pump be considerably slower than the downward stroke.

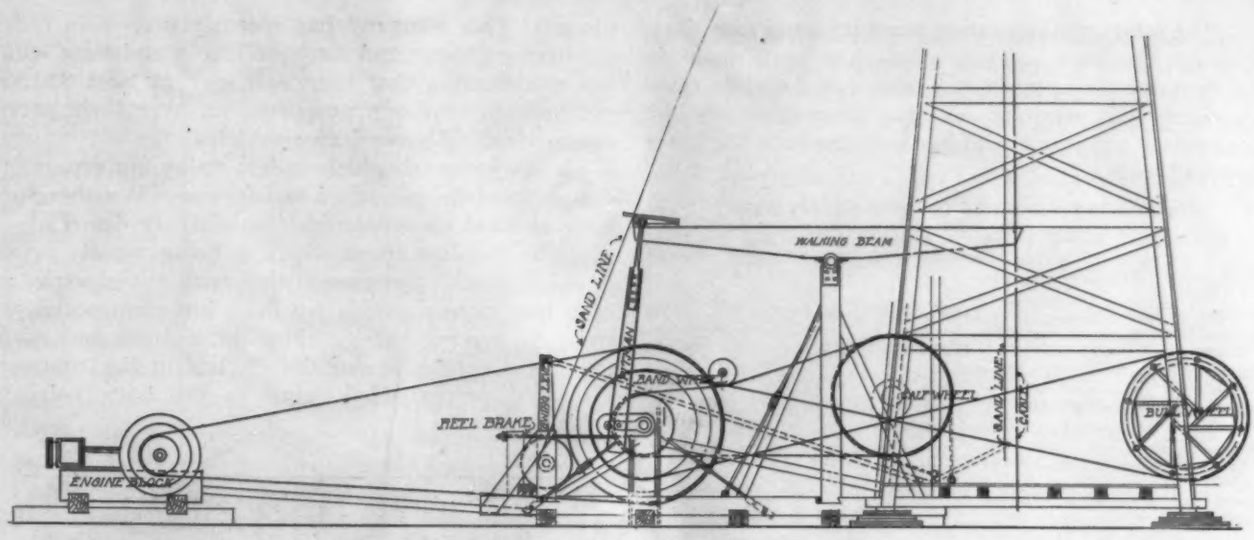
In the new fields, the pump often becomes sanded and it is therefore necessary to clean out the well. The customary method is first to pull out the pump rods and pump, which takes about 20 h.p., and then to pull out the 3 in. tubing, which will take perhaps 25 h.p. There are times, however, when it is impossible to start the pump rods and pump, and it becomes necessary then to pull up the 3 in. tubing, pump, pump rods and tubing full of oil. This requires a considerable amount of power, which will range from 50 to 70 h.p., depending upon the depth of the well. After the tubing has been pulled out of the well, they then run down a bailer which cleans out the sand.

When electrifying any particular lease, there are three problems to be considered: First, a lease with a large number of wells, the wells being such that they require cleaning only at rare intervals. It might be well to install small variable speed motors for pumping and to have several portable motors for cleaning the well, the advantage in this case being the low first cost, while there is the disadvantage of transporting the portable motors and the extra labor involved. The second proposition to be considered is where a large lease is concerned with cleaning the wells quite often. Under these circumstances, the motors installed should be of sufficient size to take care of both pumping and cleaning the wells. The third proposition applies to leases operating a small number of wells, and they should, without any doubt, install motors of sufficient size to take care of both pumping and cleaning. The California fields require cleaning quite often and therefore the large motor only should be considered.

I have forgotten to mention that it is necessary, especially when cleaning a well, to have the motor reverse its direction of rotation. The oil operators have been accustomed to reverse the steam engine from full speed forward to full speed reverse, and it is therefore necessary to have a motor that will stand this hard usage. The electrical manufacturers are therefore confronted with the following problem: to design a variable speed reversible motor with high starting and break down torque and efficient, having good electrical characteristics at the low horsepower required for pumping and at the same time to give a slower speed in the upstroke than for the down stroke. The variable speed and reversing is accomplished by using a form wound rotor of the slip ring type, controller and resistance, the variation of speed being accomplished by varying the amount of resistance in the rotor circuit.

As stated before, the pumping horsepower is considerably less than the horsepower required in cleaning, but inasmuch as the pumping operation is for about 95 per cent of the time, special attention had to be given for both good efficiency and power factor at the pumping load. This is accomplished by using a Y-Δ motor, the Δ connection for cleaning or the high horsepower duty, and the Y connection for the pumping or low horsepower duty. As an example—a motor rated at 20 h.p. for the Δ connection would theoretically have a rating of 6 2/3 h.p. on the Y connection. The Y connection, however, will be slightly higher than this, due to the fact that the excitation of the motor is considerably less than when running on the Y connection. With a motor of this design, the power factor and efficiency is practically the same when running at full load on the Y connection, as when running at full load on the Δ connection, the control apparatus having the same effect in either case. The changing from Y to Δ connection is accomplished by the use of a triple pole, double throw switch mounted in any convenient place, usually however on the motor frame.

There are several ways to connect the motor to the present wells—one method is to belt the engine shaft, using it as a countershaft by merely taking off the large fly wheel and installing a suitable pulley in its place, disconnecting the engine connecting and



Sketch of Oil Pumping Rig.

eccentric rods, or, instead of using the engine shaft a new countershaft could be installed. Another method is to install a back geared motor, the motor to set on the present engine foundation, and belted direct to the large band wheel.

Up to this time there has been quite a number of motors sold for this work, both of the belted and the back geared type. The saving to be effected by the use of electric power is considerable—in one particular case the writer's investigations showed that the cost of power would about equal the cost of boiler up-keep, that is, cleaning tubes, renewal of tubes, etc. With the installation of motors, the cost of boiler men, fuel, etc., is eliminated. In the Midway field there is one particular lease that is operating 14 wells and it is necessary to buy water for boilers from an outside source. The cost of water alone was $1200 per month, while it is safe to say that the cost of electric power for these same wells will amount to not more than $600 per month. The company, at the same time, will be saving fuel, boiler men and up-keep of boilers and steam feed mains. The total cost to electrify these 14 wells will be in the neighborhood of $10,000 to $11,000. This is a very new subject with the oil operators, but, from the favorable way they look upon it, it is safe to say that the electric power is the coming power for the oil fields.

THE VALUE OF ELECTRIC COMMERCIAL VEHICLES AS POWER CONSUMING DEVICES.

BY C. W. HUTTON.

One of the most important features to be considered in connection with procuring profitable industrial power business for the central station is to select that class of power business which will cost the least to handle. It necessarily follows that the class which will improve the load factor most will fulfill this condition. There is no power consuming device that approaches the potential possibilities, as a curative of not only the daily load factor, but the yearly load factor possessed by the electric vehicle, particularly the electric commercial type, which has a duty to perform practically six days a week and every week in the year. It is this type therefore to which my remarks will be confined.

The modern electric commercial vehicle is so designed that its battery may be properly charged after nine or ten o'clock at night and before seven o'clock in the morning. Additional wholesale business with not a cent's increase in station investment. In the commercial vehicle, due to the nature of its service, it is usually impossible that it should be placed on your lines for charging during the day time. With the commercial vehicle it is but seldom that your customer has but one vehicle. It would seem that the tremendous desirability of this character of load is beyond question or argument. The question then arises, however, as to whether or not the central station can obtain this load. The answer depends almost entirely upon the answer to the economic question: Is the electric vehicle the most economical means that can be employed for the trackless transportation of merchandise within the radius of its legitimate application? If the answer to this question is in the affirmative, the central station will obtain this load.

We often hear the question, "If the electric vehicle is what it is claimed to be, why has not greater success resulted from the efforts to introduce it during the last ten years?" The answer is simple. No important industry has been 100 per cent successful from its birth. A large and important industry to be successful requires not only satisfactory working tools, but sufficient education to be used intelligently. Electric commercial vehicles manufactured from five to eight and nine years ago are today in successful operation. True, they are not as economical as the modern vehicles, but this could not be expected. Numerous other electric vehicles manufactured at the same time met a sad fate and have been the cause of much adverse criticism of this method of transportation. The reason for this difference in results obtained by different customers with the same article has been due primarily to lack of education. This is being rapidly corrected, which together with the improvements made in batteries and mechanical details, has greatly increased the usefulness and reliability of the vehicle.

The following tabulation presents important data, showing the improvement which has been made in the 1910 one-thousand-pound vehicle of a certain manufacturer over previous designs. Approximately the same relative improvement has been made on the other standard sizes.

COMPARATIVE DATA ON 1000-LB. WAGONS.

	Vehicle and Battery, 1906	Vehicle and Battery, 1910	Per Cent Change
Weight of wagon complete (approx.)	4500	3500	—22
Weight of battery	1400	1255	—10
Capacity of battery, ampere hours	112	138	+23
Capacity of battery, kw.-hours	9.2	12.1	+32
Ampere hours per pound	.08	.11	+38
Kw.-hours per pound	.00656	.00965	+47
Current required to run loaded wagon on level (amperes)	35	23	—34
Speed of wagon on level, miles per hour	10	12	+20
Battery discharged in hours.	3	6	+100
Mileage possible on one charge	30	72	+140
Life of battery in miles (approx.)	7000	11000	+57
Cleaning required during life	3	0	..
Cost of each battery renewal	$327.00	$227.00	—30
Cost of cleaning per annum	120.00	0	..
Flushing with water, times per annum	100.00	25.00	—75

It will be seen from the above that the battery in the 1906 wagon was required to discharge at a three-hour rate, whereas in the 1910 wagon it is discharged at a six-hour rate, and that the 1906 wagon could barely run 30 miles on one charge, whereas the 1910 wagon can run 45, which is the guarantee, and have a good margin to spare.

The saving in weight has been accomplished chiefly by the adoption of a single motor, simplified transmission, lighter battery and high class steel, and not by sacrificing strength in the running gear or body.

The greater portion of the improvements indicated has been made since 1907. The modern electric wagon is a better hill climber and gives better service in every way than that of 1906, is speedy enough for traffic conditions, and has sufficient battery capacity to do a full day's work under average conditions.

The refinement of motor and control construction, the reduction of friction to a minimum, the improved mechanical design minimizing maintenance expense, the improved storage battery resulting in greatly increased capacity, longer life and reduced renewal expense combined with intelligent selling and intelligent operation has made the electrical commercial vehicle an economic success. One important example in evidence of this fact may be of interest.

One of the large brewers in New York City, the Peter Doelger Company, something over two years ago, was rabidly antagonistic to the electric vehicle because of involved experience with electric vehicles in the earlier days. As a result of continual effort they were at last induced to try a modern 5-ton truck. At the time of placing order for this truck they stated that if it would do what was claimed for it, in five months an additional order for five more would be placed. At the end of five months the additional order was received and a statement made that if these trucks gave the same satisfaction as the first one purchased, within six months an additional order for twelve would be placed. This company has recently placed an order for twelve 3½-ton and six 5-ton trucks and state without qualification that they will save at least $20,000 per year in cost of transporttation over their previous methods of horse-drawn vehicles.

The majority of vehicle orders today are repeat orders, a sure indication of satisfaction. We therefore have at hand an economical, satisfactory device.

The gasoline truck which is being rapidly introduced is really non-competitive with the electric, as each has its own respective field, but commercial activity is making the gasoline car a more and more important competitor of the electric in the commercial field properly belonging to the battery-driven vehicle.

3½-ton Truck going up Taylor St., between Pine and Bush St., San Francisco
Load. 6000 lbs.—Grade 16%

There has been one main objection to the electric vehicle which has been much discussed and on which definite information may be of interest. Many supporters of the electric vehicle have been more or less ready to concede that level street conditions were a necessity for its successful operation. It is perfectly true that an electric vehicle will not travel as many miles on one charge under conditions of severe grades as it will on a level—neither will a horse. Cincinnati is far from level, but many electric vehicles are operated there with eminently satisfactory results. Kansas City also has some extreme grades. The following letter received from the Duff & Repp Furniture Company of that city is illuminating:

"We take pleasure in handing you herewith our order for another two-ton truck, to be a duplicate of the one ordered by us last year.

"We are making 26 to 30 miles a day over the hills of our city with the truck, replacing five horses, and this order for a second machine is in consequence of the work done and our belief in the economy of your method of hauling. June 8, 1910."

The San Francisco Gas & Electric Company has been using a 3½ ton truck and a 1-ton truck under San Francisco's hill conditions for the past three months with mileage results eminently satisfactory.

Fig. 1 shows the effect of different grades on a 1-ton electric vehicle equipped with lead and with

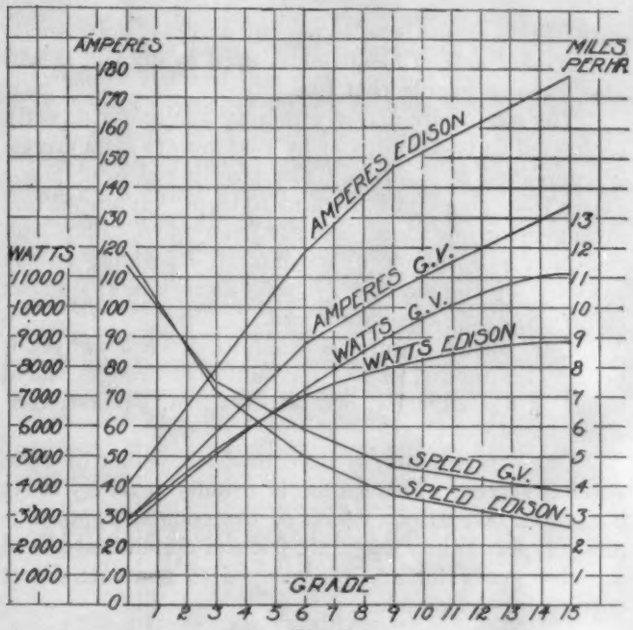


Fig. 1.

Edison batteries. Curves for other sizes would take about the same relative shape.

Fig. 2 shows curves of cost of operation per mile and per ton mile when various sized vehicles are operated the schedule of miles indicated. Cost figures include amortization at ten per cent of the original purchase price and interest on one-half the invest-

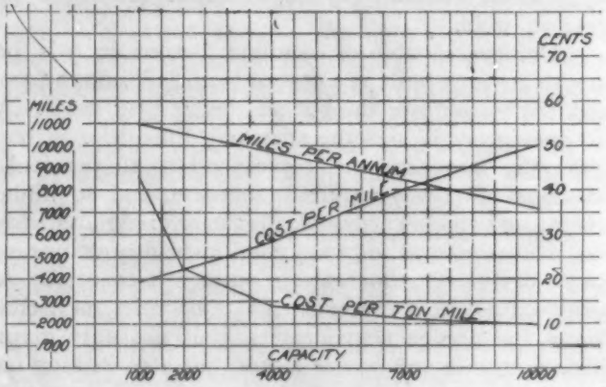


Fig. 2.

ment at six per cent. Interest is figured on one-half of the investment because the book value of the vehicle is being constantly written off. The cost figures of the curve also include liability and fire insurance, driver, garage rent, labor and maintenance and repairs of batteries, tires and vehicle, but does not include painting or repairs to woodwork. It includes current at 4c per kw. hour.

Should not electrical engineers while having the most ideal form of motive power at their command, seek to improve, standardize and cultivate its usefulness?

The electric vehicle of today is capable of doing a full day's city or suburban work on one charge of the storage battery with a margin to spare. It is probably not destined to compete with railroad transportation and we may concede for the present at any rate, that there is a large field for gasoline trucks where great distances have to be covered.

At a recent competitive test in New York City of various sizes of gasoline and electric trucks on transfer work it developed that the larger sizes of electric trucks operated at a power cost per ton mile of about one-half of the cost of the gasoline trucks. The current was figured at 4c per kw. hour, gasoline at 16c per gallon and lubricating oil at 50c per gallon. The smaller sizes of electric vehicles made practically the same showing in delivery service requiring many stops.

Requirements of modern business are becoming such that we are not merely facing the problem of a substitute for horses. There are many cases where it is more economical for the merchant to operate power vehicles even at a high cost per mile than to pack his goods for railroad transportation, and the radius of action of trackless delivery systems is, therefore, becoming extended far beyond the capabilities of horses and possibly of storage battery trucks. This fact in itself makes a field for gasoline trucks, and it is possible that the public are to some extent deceived in regard to the use of gasoline trucks which are seen on the streets of our cities.

As a matter of fact, they are used largely for long distance work and in relatively few cases have been bought to take the place of horse delivery systems, whereas the electric vehicles are actually being substituted for horses and have proved their ability to successfully compete in the cost of operation, at the same time possessing other advantages.

It is important that electric light companies and all manufacturers and dealers in electrical apparatus should not only advocate the electric vehicle but should deliver their goods with it, as every electric wagon on the street helps in creating a sentiment favorable to this form of motive power.

To add a profit bearing load at no appreciable increase in fixed charges is almost the utmost to be desired by the management of any central station. To do so at a very inconsiderable expense is almost ideal. The following table gives the earning power as compared with other current consuming devices the promotion of which has required considerable labor and expense.

ELECTRIC VEHICLES

Type of Vehicle.	Estimated kw. hours average annual demand.	Number of 550-watt arc lamps 4 hrs. daily, 300 days.....	Number of 50-watt incandescent lamps 1 hr. daily, 300 days.....	Number of flat irons 3 hrs. daily.....
5-ton truck	11,000	17	752	144
3½-ton truck	9,360	14	624	120
2-ton truck	7,440	11	496	95
2000-lb. wagon ...	5,520	9	368	70
1000-lb wagon ...	4,560	7	304	58

ESTIMATED ANNUAL KW. HOURS AVERAGE DEMAND OF INDIVIDUAL ELECTRIC VEHICLE COMPARED WITH THE NUMBER OF ARC LAMPS, INCANDESCENT LAMPS, OR FLAT IRONS OF EQUIVALENT KW. HOURS DEMAND.

The above tabulation is based on the demand 20 per cent less than the full capacity of the battery.

There are those enthusiasts who predict that within a decade a greater portion of the central station's output will be used for charging electric vehicles during non-peak hours than is furnished today for driv-

ing industrial motors. Such may or may not be the case, but here are 5 simple facts I wish to leave with you:

First. Within the sphere of its legitimate application, which includes 80 to 85 per cent of all trucking problems, the electric commercial vehicle is the most dependable, most satisfactory, most economical of all trackless vehicles.

Second. In a great percentage of the cases when a shipper has bought one modern electric vehicle for trial he has thereafter increased his equipment.

Third. Substantially all vehicles must be charged on central station current.

Fourth. Practically all charging is done at non-peak hours.

Fifth. The annual kw. hour consumption of an electric vehicle makes it, even at a preferential rate, one of the most attractive sources of income obtainable in proportion to expense of handling the business.

ELECTRIC POWER CONSUMPTION FOR GOLD DREDGING.

BY L. ETTRUP.

Figs. 3 and 4 on page 161 of the Journal of Electricity, Power and Gas, of Feb. 18, 1911, are test diagrams taken from the Marysville Company's dredger at Marysville and from the Ashburton Mining Company's dredge at Folsom. The tests were made under the writer's directions by Mr. S. G. Gassaway.

As the tests were only taken to determine what size motor to install on a new dredge under construction they must not be considered as giving an exact diagram of the work done by the motor, but only an idea of the horsepower used and the variation in load.

The following motors are as a rule used in gold dredging:

One digging motor of from 75 to 300 h.p., 3-phase variable speed (360 r.p.m. or 600 r.p.m.) usually 14 notch controllers either to be run constantly on all points or a limited time on the first 7 and any length of time on the last 7 points. The duty of this motor is to drive an endless bucket chain at a speed of from 16 to 24 buckets per minute, or from 50 to about 70 feet digging speed. By examining the h.p. curve you will find that the greatest power is used to drive the empty machinery, and you will notice that it takes more power to drive the bucket line empty in a nearly horizontal position than it does in several positions at certain depths where the ground is soft. This must be due to the fact that when the digging ladder is horizontal the full weight of the bucket line is on rollers and tumblers and as the bucket line's weight is from 50 to 100 tons a considerable amount of friction is created. When the digging ladder is on an angle only a component of the weight creates a friction on the rollers that support the bucket line. Dredgers are as a rule supplied with bigger motors than are really necessary as they are subject to variable loads. The variable speed motors are many times thrown from the 14 point ahead to reverse.

The winch motor is from 20 h.p. to about 35 h.p. 3-phase variable speed and as a rule 600 r.p.m. The duty of this motor is to swing the dredger, hoist spuds and stacker and, if head line is used to dig on, it will also have to handle that line.

The pumps are driven either by one motor directly connected to two pumps or by two motors each directly connected to a pump. The size of the first motor varies from about 75 h.p. up to 100 h.p. On the second arrangement one motor usually from 35 to 50 h.p. and the other as a rule 50 to 100 h.p. all depending on the capacity of the dredge. These motors are 3-phase, about 900 r.p.m. constant speed.

One stacker motor is used to drive a conveyor belt. This motor, in the medium size dredger, is of about 35 h.p. capacity, 600 to 900 r.p.m. 3-phase, constant speed.

One screen motor is used to drive shaker or a revolving screen. This motor is usually from 25 to 35 h.p., from 600 to 900 r.p.m. of the constant speed, 3-phase type. When magnetic friction clutches are used a motor generator set is employed to generate direct current for the clutches.

ELECTRIC POWER FOR GOLD DREDGING.

BY S. G. GASSAWAY.

In California, there are now about 130 gold dredges operating as follows:

Fifteen at Hammonton on the Yuba, 30 at Oroville, 9 at Folsom, 75 scattered in counties of Calaveras, Merced, Siskiyou, Shasta, Stanislaus and Trinity. Their combined yield is about $8,000,000 per year in gold.

Dredges capable of handling 250,000 cu. yds. per month are now built at a cost of from $180,000 to $200,000, the capacity of the buckets being 13½ cu. ft. As dredges grow in size the cost and difficulties of handling the large current, corresponding to the larger amounts of power required, increase, and so higher operating voltages are used, the latter dredges employing motors wound for 2300 volts instead of 220 or 440 as formerly. This increase in voltage is especially desirable if power is transmitted at 2300 volts, as it eliminates the dredge transformers, thus not only saving their first cost and power losses, but also making one less link connecting the dredge motor to the source of power, thus avoiding possible shut-downs due to transformer trouble. With 2300 volt motors the wiring of the dredge is simpler and considerably cheaper in first cost and installation as it is possible to use triple conductor cables. A number of dredges are now operating with 2300 volt motors.

Original dredges were operated by steam, then direct current and alternating current were both tried, the a.c. finally winning out as the most suitable. One dredge, however, which was built as late as 1908, is equipped with d.c. motors on the bucket line and winch and a.c. on other parts. Alternating current is purchased and converted to d.c. with rotary converter. This, however, has not proven satisfactory nor economical and I understand the d.c. motors are to be replaced by variable speed a.c.

One dredge recently built is provided with a synchronous motor to drive the pumps and is of sufficient capacity to operate with sufficient excess field excitation to supply the wattless current taken by the induc-

tion motors, thus relieving the station generators besides effecting a considerable saving in the power bill because of reduced line loss.

A device used on several dredges whuch has saved many dollars is a magnetic clutch on the bucket drive. This clutch is operated by direct current supplied by a small motor generator set of about 1 kw. capacity. The winchman can set the clutch to slip at any value he desires by adjusting a rheostat in series therewith. In this way the strain on the bucket line, tumblers and gears is limited. Without the clutch, should the bucket line strike a boulder or other obstruction, something is liable to break, causing shutdown. Upon striking an obstruction, the clutch slips whenever the strain exceeds the predetermined amount, this oftentimes preventing breakage and shut-down.

APPLICATION OF ELECTRICITY TO ROCK DRILLS AND DRILLING.

BY J. W. WHITE.

One conspicuous exception to the general use of electricity has been in the excavation of rock. The combination of the ruggedness of the air or steam drill with the high efficiency, flexibility and economy of electricity has long been sought and, despite many failures, a firm conviction that it would some day be realized has been generally held.

The early developments in the field of rock drilling were along the lines of least resistance, and as electricity and its application was but little known at that time, steam and air were applied because they were the easiest handled, and there was more known about their characteristics than any other two methods of applying power to machinery of this nature.

Steam was early discarded where the power was to be transmitted over any great distance, on account of rapid condensation, due to cooling, and consequent loss in power. On the other hand, wherever a steam boiler could be placed near the drills, the cost for the equipment was much less, and was a more direct application than by applying the same power to an engine, which in turn drove an air compressor to operate the same drill. For the purposes of this discussion, therefore, the operation of drills by steam may be neglected on account of the limited distance through which it can be transmitted with economy.

It is well known that the energy transformation in the use of compressed air is not high, but the fact "that it does things," some of them better than by any other means, and some which are not otherwise done, has made the matter of fuel economy of secondary importance. Therefore, no apology is needed for the use of compressed air today.

It is a well known fact, however, that air does work, and this may be compared to the compressor work, "although they have no direct relation," and in this way an efficiency may be obtained.

Types of Air Drills.

Drills may be classified as core drills, well drills, reciprocating drills and hammer drills.

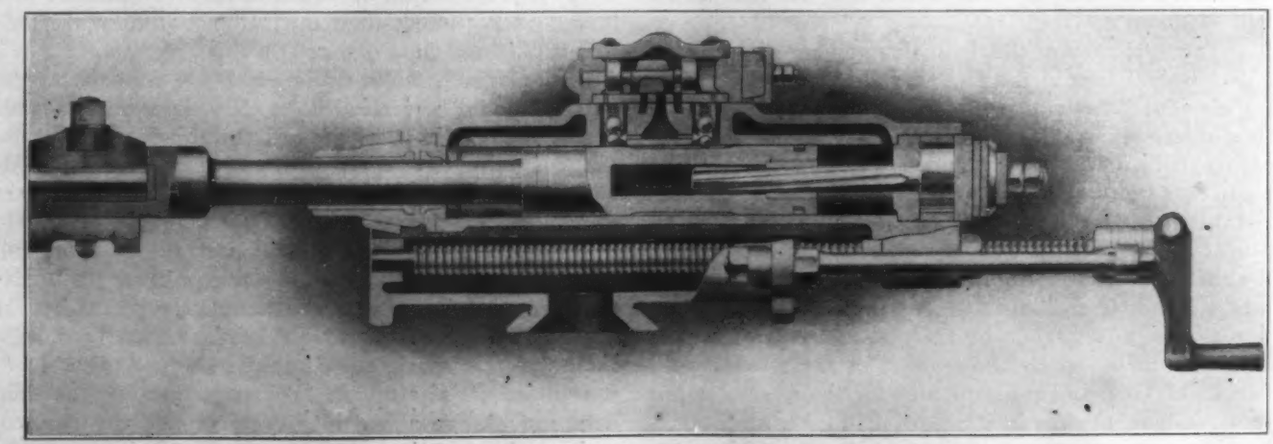
The core drill is of the rotating type, in which a core of rock is cut from the main body and drawn up with the drill. For this operation a shell is used, which in turning cuts the core free. Some types of drills employ diamonds set in the cutting edge and are known as the diamond drill. Other types have an actual cutting edge of their own, or are fed with steel shot to assist the drill in cutting the rock.

The well drill is of the familiar type used for oil well drilling or for prospecting ore-bearing ground, and its principal operation consists in raising and dropping a hammer, depending upon the impact of the blow thus given to force the drill point through the strata to be penetrated.

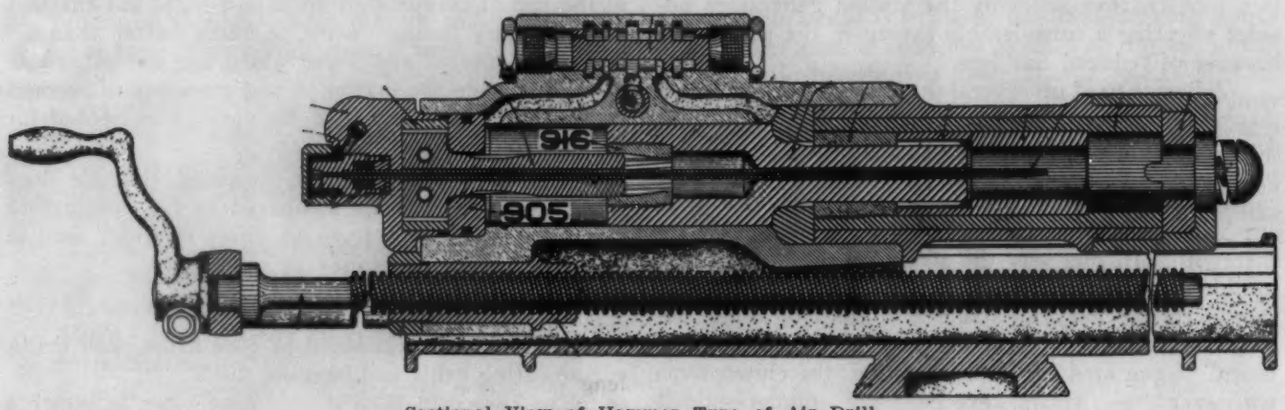
The reciprocating drill is distinguished by the fact that it has a piston, which is reciprocated by means of admitting air to either side of same, this admission being under the control of a sliding valve. In this type of drill, the steel is fastened rigidly to the piston, and the blow is given to the rock by virtue of the moving weight and its consequent velocity.

In the hammer drill a floating piston is used, which travels the length of the cylinder, due to admission of air or steam through a valve controlled port similar to the reciprocating drill. The one exception being that in the latter instance the piston is also the hammer, and delivers its blow directly to a drill steel cap at one end of the stroke which in turn directly transmits the force to the head of the drill steel.

As the application of electricity to core drills is limited only by the convenience of electric power in the territory in which operations are to be conducted, the application of electricity to this type of drill is not an important matter in this discussion.



Sectional View of Reciprocating Type of Air Drill.



Sectional View of Hammer Type of Air Drill.

In the case of the well drill, this problem has already been solved, and in other papers presented this evening the subject will doubtless be given considerable attention in connection with the drilling of oil wells.

The greatest difficulty therefore, has been in the application of electricity to drills of the reciprocating and hammer types, and with which this paper is directly concerned.

Exhaustive tests on reciprocating drills show that the combined efficiency of the drill, compressor and prime mover average between 20 and 30 per cent. This percentage varying in accordance with the type of air compressor, drill and prime mover, and while this efficiency is manifestly low from the view point of the layman, upon careful investigation it will be found that the losses in the compressor, transmission system and in the drill itself fully account for the inefficient result above given.

For instance: A 3 in. air drill of the reciprocating type when operating at 80 lb. pressure takes approximately 114 cu. ft. of free air, and with two stage compression it takes approximately .146 h.p. per cu. ft. when due allowances have been made for transmission losses, or a total of 16.7 h.p., while the indicated horsepower of a drill of this type is approximately 4.8 giving an efficiency of 28.8 per cent for a complete installation. These figures are often modified by elevation and existing conditions, as well as type of prime mover.

The hammer drill is the latest development in rock drill practice, and at the present time is still somewhat in the experimental stage. This type of drill has certain applications for which it is adapted, and which will be taken up later.

The efficiency of the drill is somewhat higher than a piston drill, due to the fact that with a smaller moving element the friction loss of the drill itself is reduced to a minimum, and for the same size as the reciprocating drill, the efficiency will be probably about 5 to 8 per cent better. This type of drill also has the added advantage that the drill steel is not reciprocated. In other words the blow is struck directly on the head of the drill steel, while the drill point is kept against the face of the hole continually. It is evident that a great deal of the power taken by the piston or reciprocating type of drill is lost by the friction of the moving drill bar in the hole, and consequently for the same amount of work done, the hammer type of drill takes about one-third less air, or about 11 h.p. per drill. In comparison with a 3 in. drill of the reciprocating type, which drill will consume about 16.7 h.p.

It should be noted here that the efficiency of the drill is entirely foreign to the footage of rock drilled and should not be confused with it. The amount of rock drilled depends on other factors in addition to the power applied as will be shown later.

In small drills of the hammer type no water is used in drilling, consequently their application is limited to uppers and holes above the horizontal. Therefore, machines of this type are made in small sizes for work in small stopes, headings, etc., and are of such weight that they can be handled by one man.

These drills are not applicable for drilling horizontal or down holes, on account of the fact that they will not clear, and consequently stick, all turning of the drill steel being manual. In the large sizes, common practice is to carry water to the point of the drill by means of the hole in the center of the drill bar. With this type of drill it is possible to drill both uppers, horizontals and down holes, although the greatest difficulty is met on the vertical down holes.

Coming now to the question of application of drills to different kinds of work, it has been found that hardly any type of air drill at present on the market is satisfactory for all work.

For instance: The piston or reciprocating drill will work on down holes and uppers, but is at its greatest disadvantage on horizontal holes on account of the fact that it is impossible to get water into them, and they will not clear themselves as well as uppers. On the other hand, the hammer type of drill in the small sizes is successful on uppers wherein the clearance feature does not effect their operation, but they are limited to this one class of work on this account.

The large hammer drills which use water are good on uppers and horizontal holes, but experience considerable trouble in clearing on down holes where the muck is liable to clog the drill and thus assist in deadening the rebound, so that in turning the drill wears itself away on the face of the hole.

Both of these types of drill use crossbit steel and some of the hammer drills use a five pointed steel. Experience has shown that the hammer type of drill at present has the highest maintenance cost, although their work is much more rapid. On the other hand it is more satisfactory in broken ground, as the drill does not plunge ahead into crevices like the reciprocating drill. At the present stage of development, the

piston drill holds the advantage over the hammer drill in the cost of excavation per foot, although it is quite probable that the hammer drill actually drills faster than the piston type, but is much more complicated, and if the expense incurred by the fact of its being out of commission were added to the maintenance, the probable cost per foot of ground broken would be considerably in favor of the piston machine. It is quite probable however, that the new improvements along the line of air drilling are mostly in the hammer type of machines.

The Electric Drill.

With the above brief history of air machine work, we can take up the development of the electric drill. It has long been realized that the successful application of electric power to rock drilling would result in a much greater economy and give a lower first cost of installation as well as being more flexible on account of portability of individual units.

With the air machine it is necessary to have a compressor of sufficient capacity to handle the number of drills operated, and it is needless to say that the standby losses when only a portion of the equipment is in operation are considerable. It is also necessary to buy a large machine for the initial installation, (which the customer is often not warranted in purchasing), simply because he expects to put in more drills at a later date.

The cost of running pipe lines, etc., is a considerable item, and the losses in air transmission are at least three times as great as in electrical application.

The first style of electric drill designed was of the solenoid type, using two opposed solenoids and an alternating current generator of very low frequency, the number of blows struck being equal to the frequency of the generator. It is needless to state that the efficiency of solenoid operation is not of the best and the reciprocating action made a wreck of a seemingly simple design. The greatest fault with this type of drill was that the greatest moment exerted upon the drill steel was at the beginning of the stroke, and as the core entered the solenoid, the magnet pull fell off appreciably so that at the end of the stroke the drill was receiving practically no energy from the solenoids. On this account it was necessary for the drill runner to give the drill considerable attention, as the blow depended upon the position of the solenoid core at the time the blow was struck.

Another early design used a motor which compressed a spring on the return stroke of the drill, tripping it with a trigger at the proper time so that the impact to the drill steel was delivered by this spring in expanding.

This type, like the first, is at a disadvantage because the effect of the spring is least at the end of the stroke, therefore, the impact of the blow is dependent upon the velocity of the reciprocating part gained on the first portion of the stroke. A great deal of trouble was experienced with the springs and in the lubrication of the drill, while the drill itself was of such a weight that it was bulky to handle.

Another development following this was of a drill electrically driven, but operated by compressed air. A small motor was direct geared to a double acting compressor, which contained but two inlet valves, and which was connected by flexible pipe to a standard air machine, which also was equipped without valves. In this drill, the piston was moved back and forth by the transmission of pressure from the pistons of the air compressor, and this was the first practical electrically operated drill (if it can be called such).

With this machine it is possible to do the same work with about 5 h.p. that the reciprocating air machine does with 16.7 h.p.; a saving of 11.7 h.p.

This drill is still upon the market and is successful in places where it is possible to carry the compressor with the drill, as it is necessary to have the length of hose between the compressor and the drill as short as possible, in fact, within 7 to 10 ft. It is therefore, impractical to use them in shafts or in small stopes, and their work is limitel to open quarries and faces of tunnels where the compressor can be pushed back when the charges are fired.

The compressor and motor on these drills weighs in the neighborhood of 900 lb. and the complete equipment approximately 1200 lb. It is therefore, apparent that while these drills will be successful in certain classes of work, their field is limited.

The next development in electric drills was what is known as the air-electric, in which a piston is operated through a scotch yoke (or an ordinary crank) and gears by a motor. The motor being mounted upon the guide shell of the drill. The drill itself is entirely separate from the piston already mentioned and is operated by an air medium. By combining the motor and drill upon the guide shell, much weight was avoided, but it is all concentrated in the drill itself, making it bulky to handle, either upon a tripod or a standard.

These last two drills were open to the same fault as all others of the electric drills in the past, that is that the least amount of energy was being transmitted to the piston at the end of the stroke, on account of the crank passing a dead center.

In addition to this the question of lubrication, the difficulty experienced in changing rotary to reciprocating action, made the upkeep of this latter drill prohibitive, and as far as it is known they are not in general use at the present time. One of the later drills used the same principle but instead of having a motor driven piston, the cylinder wall was reciprocated, thus changing the valve action, so that the same effect was produced through ports.

With this type of drill it was claimed that a 4 h.p. motor would do the same work as a 3 in. reciprocating air machine, but as this has never been generally proven, its operation over a wide range of conditions and a long period of time makes this guarantee a matter of conjecture.

The types of electric drills just mentioned constitute most of the attempts to produce a successful reciprocating drill, and most of the later designs are using the hammer principle.

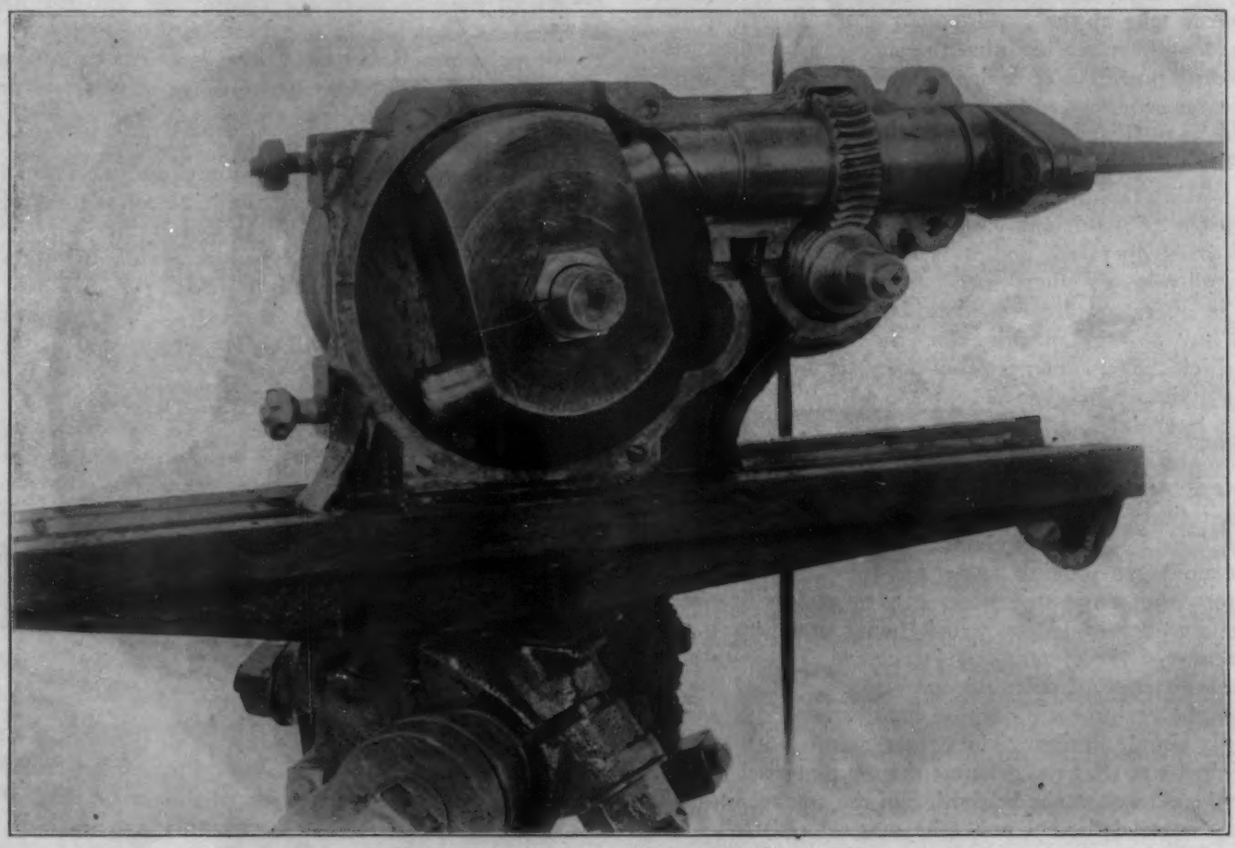
One of the latest drills of this design is an air-electric drill, similar to the reciprocating drill previously mentioned, except that as in all hammer types of drills, there is a floating piston only, which delivers its blow to a stationary drill bar.

This type of drill will be probably much more successful than the air-electric reciprocating drill, but its

operations has shown that it is open to the same objection as the other electric drills, i. e., since it is operated by a crank which slows down as it approaches the dead center at the extreme end of the stroke, the striking mechanism is not designed to get the most efficient results. The striking hammer should be at its maximum velocity when it strikes the drill steel. In order to overcome this feature it is necessary to employ springs or an air cushion so as to accelerate the hammer and to compensate for the decreased speed of the piston at the end of its stroke. The air pad of course, acts as a flexible connection between piston and striking hammer.

At the present time electric drills have been developed to a point where they give from 50 to 70 per cent efficiency including electric losses, and due to certain principles of design, it is possible at the present time to do the same work with an electric drill with one-tenth the power, that is consumed by the air machine of reciprocating type.

The small amount of power taken is not due to the efficiency of the drill alone, but in great measure to the manner in which the blow is struck. Experience has shown that the drilling effect is directly proportional to the impact of the blow multiplied by the number of blows in a given time, and that over wide variation



Sectional View of Hammer Type of Electric Drill.

Of late there has been another type of electric drill placed upon the market, in which there is no change from rotary to a reciprocating motion in the striking mechanism. In this drill there is a rotating helve or hammer block which gives a fly wheel effect, and in periphery of which are seated two striking hammers This helve is driven by a motor mounted on the guide shell by a belt, and as the helve rotates the hammers fly out by centrifugal force delivering their blow upon the drill cap and cushioning upon the trapped air in the chamber behind the hammer.

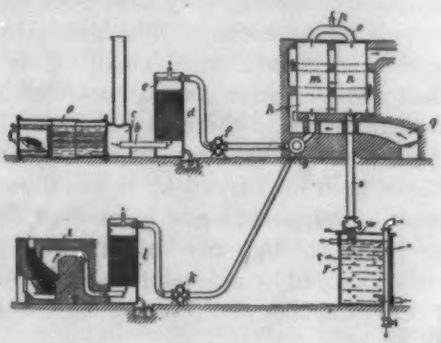
In addition to this the steel is given a positive turning motion, and the drill steel has a forged spiral wing which acts as a conveyor to bring out the cuttings. In this drill the maximum velocity of the hammer is attained at the instant of striking and gives the most direct application of imparted energy to the drill steel. This drill is the nearest to the hand method of "single-jacking" which has yet been devised, and its operation will be watched with considerable interest.

in the number of blows and the impact of them the amount of rock drilled is about the same. On the other hand the lighter blow gives longer life to the drill steel, and in doing away with the reciprocating type of drill a great deal of energy is saved on account of losses incurred by the drill bar in the hole itself.

It is problematical whether a drill will ever be designed which will operate as well under all conditions as a drill designed for one class of work only, but to successfully design an electric drill, it is necessary to get away from reciprocating action, to mechanically turn the drill so that each blow will be in virgin rock and provide a suitable method of clearing the hole so the drill will not stick. The present trend of development appears to be along the line of hammer drills and from present indications the time is not far distant when electric drills will take the place of the large air machine drills, although it is quite probable that the small air stoping drills will be used for a few years to come.

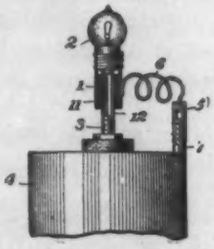
PATENTS

984,605. Method of Producing Nitrogen and Carbon Dioxid from Gaseous Products of Combustion. Max Reichel and Heinrich Braun, Berlin, Germany, assignors to Nitrogen-Gesellschaft, M. B. H., Berlin, Germany. The herein described



method of producing nitrogen and carbonic acid from ordinary products of combustion, which consists in mixing therewith a gas having a reducing action, passing the mixture thus produced in contact with hot copper and copper oxid, and separating the water, the carbonic acid and the nitrogen.

985,018. Battery Lamp-Socket. George N. Eastman, Riverside, Cal., assignor, by mesne assignments, to Eugene C. Brown, Washington, D. C. In an article of the class described a tubular metal casing having a lamp-base receiving means at one extremity and forming a contact for one of the

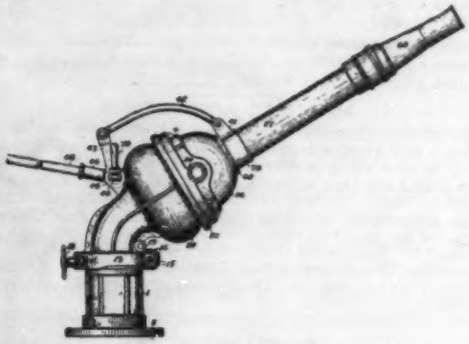


lamp terminals, an inner combined support and terminal member having means for attachment to a contact terminal an intermediate insulating bushing within said outer casing and having a contact projecting centrally therefrom to engage a lamp terminal, an auxiliary terminal connector external to said casing and a flexible conductor connecting said auxiliary connector and one of the lamp contacts.

985,021. Antiseptic Telephone-Mouthpiece. William M. English, Sausalito, and Louis E. Boukofsky and Solomon M.

Lichenstein, San Francisco, Cal. In a combination with a telephone mouthpiece, a holder secured to said mouthpiece and having formed integral therewith an outer wall and an inner cylindrical wall, spaced from the outer wall or casing of the holder to form an annular recess, the edge of said inner wall being spaced from the mouthpiece adapted to contain absorbent material, substantially as described.

984,557. High-Pressure Nozzle. Henry H. Gorter, San Francisco, Cal. In a high pressure nozzle, the combination of a tubular outer portion formed in its inner surface with a lower run-way for balls, a nozzle, a sleeve within said outer portion, carrying the nozzle, a ring secured upon the lower



end of said sleeve, a ring of balls between said ring and runway, said sleeve having at its upper end a flange, and rollers carried by said flange, bearing against the side of said tubular portion adjacent to the nozzle, the axis of said rollers being parallel with the axis of the sleeve, substantially as described.

985,052. Oil-Well Pump. Marshall J. Morton, Los Angeles, Cal., assignor of one-half to James I. Wagy, Los Angeles, Cal. An oil-well pump provided with a plunger and outside snap packing rings outside of the plunger body and outside

of the sanding valve, and provided with an automatic sand agitator to keep the sand loose within the plunger, said agitator being arranged to engage the valves of the plunger and standing valve to prevent the same from sticking.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

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TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.25
Single Copies, prior to Current Month	"	.25

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

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Electric Drive

Fifteen years ago, after electric drive had supplanted the steam engine or water-wheel as the prime mover in industrial works, when the change was one not so much a matter of operative expense as of expediency, engineers and prophets began drawing on their ingenuity and imagination to widen the field of its usefulness, and to give the electric motor an industrial individuality in addition to its position as an improved substitute. The idea, once started, opened a vista of opportunity, not only in the application of electric drive, but in making possible lines of industry heretofore not considered possible. The usefulness has therefore been two-fold, in that new industries have been thus created. It has been like the development of ordnance; a gun is invented which will drive a projectile through any known armor, which is immediately followed by a development in armor plate that will resist the shot and then the cycle is repeated again and again.

In the West where gold in relatively small quantities has been found in the gravel of the river deltas, the comparatively new dredge mining has grown to a giant industry. It is true dredge mining is carried on where steam power only is available, but the simplification of the electric equipment and the low cost of upkeep and operation, has made possible the profitable working of many gravel beds which otherwise might never have been touched.

Other industries have required the utmost skill and operative ability to be made adaptable to electric drive, which after installation soon proves its efficiency. In this connection pumping in small units for irrigation and use in the oil well industry are interesting. In the first case the motor must compete with gasoline power which need be only periodically used; and in the latter case oil fuel at low cost or free is an obstacle which appeals readily to the imagination of the power user.

The electric vehicle industry is limited, not by its electric drive, which is ideal, but by its intermittent connection with the source of power and the necessity of carrying storage batteries.

Electric drive for rock drilling has been a problem the benefits of which have long been apparent to engineers and miners. But the problem has been one of mechanical application signalized by many failures. It looks now as if the long sought for goal is at hand and a new era commenced in the rapidity and low cost of rock excavation.

Still another and very different use, which, now that it has been created, is indispensable to our daily domestic life and happiness, is the vacuum cleaner. A decade ago it was not economically possible, today no public building or hotel is considered sanitarily clean without it. Perhaps the broadest application of electric drive, created from its possibilities, but most affecting human comfort has been the development of the electric fan. The industry of manufacturing fans of every description and for all purposes has grown to great proportions.

PERSONALS.

Charles C. Moore of Charles C. Moore & Co., engineers, has gone to New York City.

H. F. Nanenz, an electrical contractor of Santa Cruz, was a recent San Francisco visitor.

Thomas Mirk, of Hunt, Mirk & Co., left for San Diego on engineering business last Monday.

S. N. Griffith, an electric railway builder of Fresno, recently spent a few days at San Francisco.

S. K. Colby, of Pierson, Roeding & Co., has returned to San Francisco after a trip to Puget Sound.

C. R. Ray, president of the Rogue River Electric Company of Medford, Ore., is visiting Los Angeles.

W. S. Heger, the California manager of the Allis-Chalmers Company, spent the past week at his Los Angeles office.

George H. Parker, manager of the United Wireless Telegraph Company's Seattle office, was a recent arrival at San Francisco.

Otto E. Osthoff, one of the vice-presidents of H. M. Byllesby & Co., of Chicago, arrived at San Francisco during the past week.

John Martin, who is interested in the Coast Counties Electric Power Company, has returned to San Francisco after an Eastern trip.

W. J. G. Lambert, one of the original promoters of the Home Telephone Company, arrived at San Francisco from Los Angeles last Saturday.

M. S. Hopkins, of the Clark Syndicate, which owns the Portland Railway, Light & Power Company, of Portland, Oregon, is a San Francisco visitor.

C. H. Bennett, manager of the operating department of the Pacific Electric Railway of Los Angeles has been spending a few days at San Francisco.

H. M. Winter has resigned as manager of the Seattle office of the General Electric Company to become general manager of the Seattle Electric Company.

C. E. Grosbeck, one of the vice-presidents of H. M. Byllesby & Co., with headquarters at Portland, returned last week from a trip to Japan and China.

Roy C. Wolden, general manager of the California Electrical Construction Company, recently returned to the San Francisco branch, after a month's absence in the East.

Thomas E. Collins, of the sales department of the Westinghouse Electric and Manufacturing Company, has returned to the San Francisco office after an Eastern tour of six weeks.

G. R. Field, assistant general manager of the Great Western Power Company, left last Monday for a trip covering the hydroelectric transmission system between Oakland and Big Bend.

C. M. Bliven, sales agent of the General Electric Company at San Francisco, has been made manager of this company's office at Seattle, Wash. He has been succeeded at San Francisco by Wm. M. Shepard.

W. G. B. Euler, superintendent of the Big Bend division of the Great Western Power Company, has returned to the hydroelectric plant on the Feather River, after spending a month's vacation in Southern California.

Wynn Meredith, manager of Sanderson & Porter's Pacific Coast branch office, spent the past week in Southern California, visiting among other places the manufacturing plant of the Pacific Electric Heating Company at Ontario.

E. A. Klose, who was formerly with the Mutual Electric Light Company, is now chief engineer of the South Side Light and Power Company's new steam-turbine power station on Minna street, near New Montgomery, San Francisco.

A. J. Churchill, president, and A. J. Rosborough, secretary, of the Yreka Electric Power and Light Company, have returned to Yreka, after spending a week at San Francisco in conference with their engineers, F. G. Baum & Co., regarding plans for extensions of their hydroelectric system.

Geo. S. Nickerson and Carl Maughmer have opened offices as civil and hydraulic engineers in the Ochsner Bldg., Sacramento, Cal. Mr. Nickerson has just finished the construction of a concrete steel bridge at Winnemucca, Nev., and Mr. Maughmer is assistant State engineer of California.

S. G. Gassaway has resigned from the engineering department of the General Electric Company at San Francisco to accept a position with the Kern River Oil Fields, Ltd., at Bakersfield. This company will install a large number of General Electric motors for oil well rigs, etc. H. C. Stanley succeeds Mr. Gassaway with the General Electric Company.

LOS ANGELES ELECTRICAL LUNCH CLUB.

The next regular monthly meeting of the Electrical Lunch Club of Los Angeles will be held Thursday, March 9, at the Hollenbeck Hotel. Mr. Geo. A. Damon of the Bion J. Arnold Co., will speak on "Transportation." All electrical men in the vicinity at this time are invited to attend.

TRADE NOTES.

The Bowers Rubber Company have decided to substitute electric power for the present steam installation at their Bay Point (Cal.) factory, contracting for about 500 h.p. from the Great Western Power Company.

George A. Johnston of Los Angeles, Cal., has moved his office to 551 South Los Angeles street, where he will continue to act as sub-agent for the Wagner line of alternating current motors, generators, transformers and instruments.

The Natomas Consolidated of California, Marysville, Cal., has ordered about 1000 h.p. in motors from the Westinghouse Electric & Mfg. Company, Pittsburg, Pa. The motors will be used in operating a gold dredge. It is interesting to note that the use of 2200 volts direct on the motors has proved successful on a electric dredge that the company already has in operation and that the new motors will operate on the same voltage.

The General Electric Company has sold to the Los Angeles Railway Company two motor generator sets described as follows: One 2-bearing set consisting of I. 12, 1400 h.p., 500 r.p.m., 2200 v., form K, induction motor, direct connected to an M. P. C. 8, 1000-kw., 600-v., compound wound generator. One 3-bearing set consisting of an I. 8, 900 h.p., 750 r.p.m., 2200 v., induction motor, direct connected to an M. P. C. 6, 600 kw., 600 v., compound wound generator.

The General Electric Company reports the following contracts closed for electrical equipment: To the San Francisco Gas & Electric Company for use at San Francisco, a 15,000 kw. steam turbine rated as follows: One A. T. B. 10, 15,000 kw. (18,750 k.v.a. 8-10ths p.f.) 720 r.p.m, 11,000 v., vertical Curtis turbine generating set with condenser base; for use at Sacramento a 12,000 kw. steam turbine as follows: One A. T. B. 10, 12,000 kw. (15,000 k.v.a., 8-10ths p.f.), 720 r.p.m., 4150 v., vertical Curtis steam turbine generating set, with condenser base; and for installation at San Rafael, one A. T. B. 4, 5000 kw. (6250 k.v.a., 8-10ths p.f.), 1800 r.p.m, 4150 v., horizontal condensing steam turbine generating set.

INDUSTRIAL

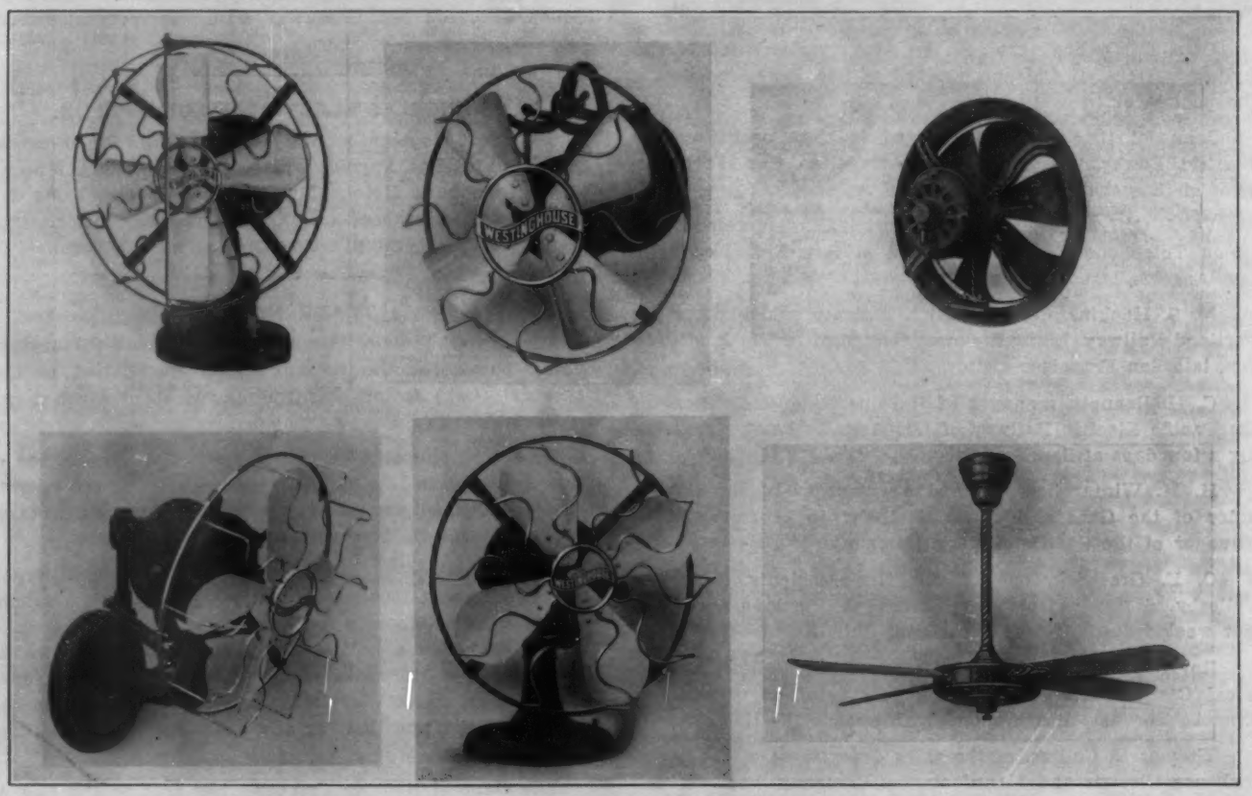
WESTINGHOUSE FANS FOR 1911.

The 1911 line of fan motors of the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., includes all of the types furnished in 1910 with the addition of several new designs. The fans built by this company now include alternating and direct current fan motors for all purposes; desk and bracket fan motors of the swivel-and-trunnion, mechanically-operated oscillating and air-operated oscillating types with 12 in. and 16 in. blades; 12 in. six-blade residence type fan motors; 8 in. desk and bracket fan motors; 8 in. telephone booth fan motors; a complete line of ceiling, counter column and floor column fan motors; and 12 in. and 16 in. exhaust fan motors with either Westinghouse standard or Blackman blades. The alternating current fan motors are designed for 25-30, 40, 50, 60 and 133 cycles, 110 or 220 volts; the direct current fan motors are designed for 30, 50, 110 or 220 volts, except the ceiling and column types which are not built for the battery voltages.

The aim in the design of the Westinghouse fan motors has always been quality. The alternating current motors are designed for high power factor and high efficiency. With the exception of the 8 in. types these are induction motors starting on the split phase principle. In the desk and bracket types the starting winding is automatically cut out by means of an efficient switch when the motor attains speed. The direct current motors and the 8 in. alternating current motors are designed for high efficiency and sparkless commutation. The armature cores are built of laminated steel with the coils enclosed in slots, and the wall designed commutators and rectangular brushes prevent operating troubles. Most of the fans are lubricated by grease cups feeding through wicks, and the ceiling fans have in addition ball bearings.

The 12 in. and 16 in. desk and bracket swivel-and-trunnion fan motors are adjustable through a wide angle and are clamped firmly in any position. An adapter is furnished for bracket use, which can be inserted between the motor body and the base without opening the circuit.

The 12 in. and 16 in. mechanically operated oscillating fan motors are an addition to the Westinghouse line. The fan is of the same construction as the swivel-and-trunnion type, having a wide adjustment above and below the horizontal. The oscillator mechanism consists of a double worm reduction and a single oscillating lever. The gears are enclosed in a case packed with grease. The arc of oscillation is adjustable within 90 degrees. These fans can be quickly arranged for wall mounting by means of an adapter similar to that used with the swivel-and-trunnion fans.



Westinghouse Fans for 1911

Air operated oscillating fan motors are still furnished in 12 in. and 16 in. sizes for use where oscillation in the horizontal plane is sufficient. The angle of oscillation is adjustable by means of movable stops, in 30 degree steps. If desired the stops can be removed and the fan allowed to revolve continuously. The use of contact rings to conduct the current to the motor makes this possible. A substantial bracket is furnished for wall mounting.

The Westinghouse 12 in. residence fan motors are particularly applicable for hospitals, libraries, sleeping rooms or other places where quiet is essential. The fans operate at low speed but have six blades set at a high pitch instead of four. Otherwise they are the same as the desk and bracket types.

The 8 in. desk bracket fan motors have become very popular for use where the strong breeze of a large fan is undesirable. The bodies and bases of these motors are of pressed sheet metal, finished in black oxide, mottled copper,

polished brass or brushed brass, and present a very attractive appearance. The 60-cycle, 110-volt motors of this type can be used with a special converting base on 25 to 50 cycles or on direct current of the same voltage A swivel arrangement in the base makes it possible to mount the fan either in a vertical position or on the wall, and makes vertical angular adjustment possible.

The 8 in. telephone booth fan is identical with the 8 in. desk and bracket type, except that the motor body is suspended from a bracket by four springs which prevent vibrations being transmitted to the telephone.

The Westinghouse ceiling and column fan motors have in past years demonstrated their dependability, and their success where the distribution of a moderate breeze over a wide area is desired, has been gratifying to both the manufacturers and customers. The alternating current fans are built with 56-inch blade sweep, one-speed fans finished in black japan and three-speed fans finished in mottled copper. The direct current fans are built in 32 in., 54 in. and 57 in. sizes, with various finishes. Ceiling fans and column fans are identical except for the method of mounting, and in general column fans are used where the height of the ceiling will not permit the use of the ceiling type. The counter column fan motors have 36 to 48 in. clearance between blades and base, and floor column fans about 7 ft. All of these fans have substantial blades of hard wood with mahogany finish.

An addition to the Westinghouse line is a design of 12 in. and 16 in. exhaust fans with Blackman blades. These fan motors are furnished with six blades of a special shape designed to operate efficiently against pressure. The slow speed enables these fans to exhaust with a minimum of noise. Either standard blades or Blackman blades can be furnished with the exhaust fan motors.

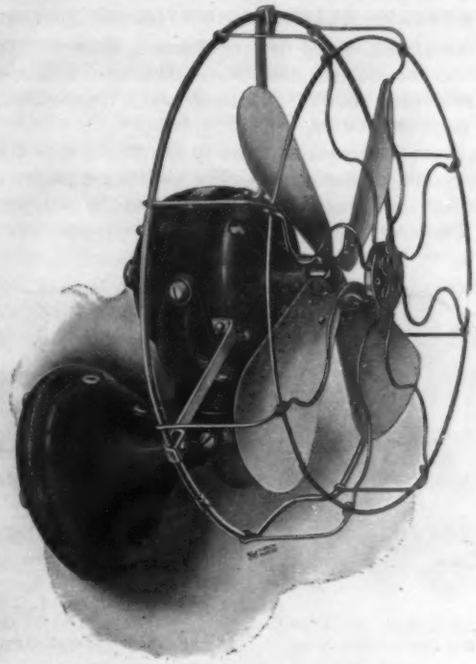
G. E. FAN MOTOR MODELS FOR 1911.

The General Electric Company's fan motor models for 1911 represent an exceptionally complete line designed for satisfying the requirements of a wide field of application. Several marked improvements are noticeable, one of particular importance being the adoption of a new induction winding for the 8, 12 and 16-inch alternating current fans, which obviates the use of a centrifugal switch for controlling the starting winding, thus eliminating all noisy contacts and insuring quiet operation with low energy consumption and great speed range.

G. E. Alternating Current Plain Type Ceiling Motor.

The entire line includes both a.c. and d.c. 8-inch four-blade desk, bracket, oscillating and telephone booth fans; 12-inch 6-blade residence, bracket and oscillating fans; 12 and 16-inch standard desk and bracket fans; 12 and 16-inch oscillating fans for either desk or bracket use; together with a great variety of ceiling counter column and floor column motors of attractive plain and ornamental design.

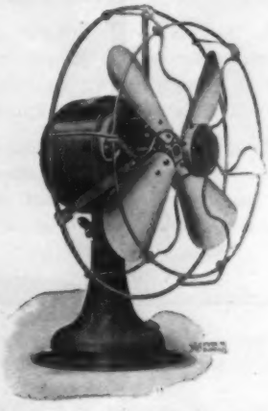
The desk, bracket and oscillating fans in general are readily convertible for either desk or bracket use and vice versa, by means of a hinged joint, attaching the motor body to the base, which permits of an extremely simple and quick vertical adjustment. The telephone booth fans are suspended from suitable brackets by means of a spring suspension, thus preventing any vibration from being transmitted



G. E. Alternating Current Bracket Fan Motor.

to the walls of the booth. The six-blade fans operate noiselessly and are designed especially for use in residences, hospitals and other places where quiet operation is desirable.

These motors are equipped with suitable switches for giving three speeds, the maximum ranging from 1250 to 1600 r.p.m., thus providing a regulation sufficient for all requirements. The a.c. motors carried in stock are for circuits of 25 cycles at 110 volts; 40 cycles at 120 volts; 50 cycles at 100,



G. E. Alternating Current Desk Fan Motor.

110, 220 and 220 volts; 60 cycles at 110 and 220 volts; and 133 cycles at 110 volts. The d.c. motors are for 110 and 220 volt circuits.

The a.c. ceiling and column fan motors are designed for operation on 25, 40, 50 and 60 cycle circuits. The plain types have two speeds, ranging from 150 to 225 r.p.m. The d.c. motors are designed for 110 or 220 volt circuits. The plain

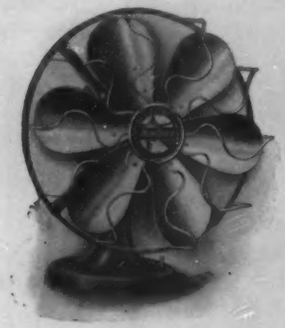
types operate at 200 r.p.m. The ornamental single speed types operate at 200 r.p.m., and the three speed types at 100, 150 and 200 r.p.m.

Both the a.c. and the d.c. fans are of the four-blade type, the former have a sweep 52 inches, and the latter 58 inches. They are of handsome design, workmanship and finish, and are wired for electrolier attachments of two or four lights.

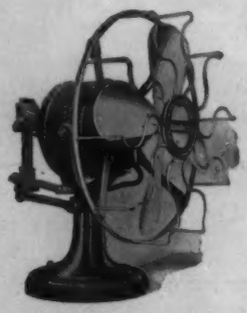
NEW "WESTERN ELECTRIC HAWTHORN" FAN MOTORS.

To the already large list of "Western Electric Hawthorn" electric fan motors five new types have been added, and the line is now such that it will meet every requirement necessary to good ventilation.

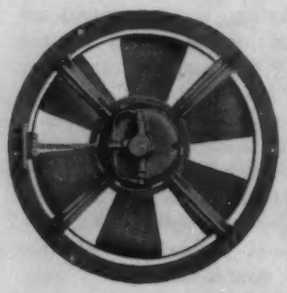
The most important addition to the line is a new mechanically operated oscillating fan. The oscillating device consists of a double worm reduction controlled by an oscillating lever. The gears are enclosed in a dust-proof case which



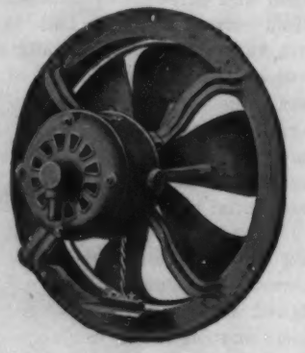
12 in. A. C. Residence Type Desk and Bracket Fan Motor.



12 in. Hawthorn A. C. Mechanically operated oscillating fan as desk type.



16 in. D. C. "Hawthorn" Ventilating Fan with Blackman Blades.



16 in. A. C. "Hawthorn" Ventilating Fan with Blackman Blades

is filled with lubricant. Tool steel is used for the worms and phosphor bronze for the worm wheels, thus insuring long life for the mechanism. In this fan the much desired trunnion feature is retained, thus making a wide adjustment in the

32 in. "Hawthorn" D. C. Ceiling Fan

vertical plane possible when the fan is used either as a desk or a bracket type. The oscillating motion is smooth and even, and wholly free from jarring. The range of oscillation is 90 degrees and is adjustable.

The success of the 12-inch, alternating current, six-blade residence fan introduced last year has led the company to place on the market this same style of fan for use on direct current circuits and also an oscillating fan of the six-blade type. As the increase in the number of blades allows the speed to be cut down without any decrease in the volume of air moved, this fan operates noiselessly, and because of this fact has become popular. It can be adapted for use either as a wall or bracket type and has two speeds.

Another type of direct current fan has been developed, known as the 32-inch ceiling fan. This fan is attractively designed and is well adapted for use in small offices, houses, hotels, clubs, etc.

In exhaust fans the popular "Hawthorn" fans are being furnished with the well known Blackman blade, a feature which will be appreciated by all users of small ventilating outfits.

The line of "Western Electric Hawthorn" fans now consists of 8-inch, 12-inch and 16-inch desk and bracket fans; 12 and 16-inch oscillating fans; 8-inch telephone booth fans; air operated and mechanically operated oscillating fans and a full line of battery fans, ceiling fans, column fans and exhaust fans for all commercial voltages. These fans are made in various sizes for use on all standard commercial circuits, both alternating current and direct current.

NEW CATALOGUES.

The Fort Wayne Electric Works is distributing a handsome book of souvenir views of Fort Wayne, "Indiana's busiest, happiest city."

The Southern Pacific Company has issued an excellent map of California, 20x24 in., together with a brief description of its resources, attractions, topography and climate. The map is in colors, different colors designating the characteristic climate of each section.

Westinghouse Electric Fan Motors for 1911 are fully illustrated and described in detail in Circular No. 1165 from the Westinghouse Electric & Manufacturing Co. Folders 4100 and 4101 give more condensed statements regarding alternating and direct current fans respectively.

The Pacific States Electric Co. of San Francisco, Oakland, Los Angeles and Portland, has issued a 936 page catalogue of electrical supplies and machinery, telephone and construction material. This volue is substantially bound and beautifully printed and is a veritable encyclopedia for the electrical purchaser. Apparatus listed includes sockets (57 varieties), receptacles, fuses, switches and switchboard equipment, insulators, line material and linemen's tools, conduit and fittings, electric heating appliances, fans, flashes, batteries, electric lamps and fixtures, motors, meters, telephones and telegraph equipment of all kinds, wire and cable, together with a wealth of wiring data. The catalogue as a whole is the largest and most complete ever issued by a Pacific Coast house. It is supplemented by a price list embodying several unique and valuable ideas to facilitate its use.

NEWS NOTES

FINANCIAL.

DORRIS, CAL.—The election held here on Tuesday resulted in favor of issuing bonds to the extent of $12,500 for the purpose of constructing a municipal waterworks system and supply.

LAS CRUCES, N. M.—The Board of Trustees of Las Cruces will call a bond election to vote on the question of issuing bonds for the construction of a municipal water-works and sewerage system for this city.

ILLUMINATION.

DAYTON, WASH.—The Dayton Electric Company has applied for a franchise for an electric lighting plant here.

THE DALLES. ORE.—The Aldermen are figuring on erecting an electric light plant. No definite plan has been suggested.

OREGON CITY, ORE.—The Mt. Hood Railway & Power Company has asked for a franchise to furnish this city with cluster lights. E. T. Bowness is the engineer.

PORTOLA, CAL.—An electric light plant will be installed soon. The company was incorporated six weeks ago with C. H. Gardner, president, and D. L. Tyre, vice-president and general manager.

SAN FRANCISCO, CAL.—It is announced by the City Electric Company that stockholders who desire to join a pool of not less than two-thirds of the entire stock may deposit their shares until August 1, for sale at not less than $80 per share.

IMPERIAL, CAL.—C. S. Chestnut of Redlands, representing Redlands and Los Angeles capitalists, has presented to the City Trustees a proposal to build and have in operation within five months, an electric light plant, if given a contract for lighting the streets at a rate not greater than the present rate.

TRANSMISSION.

BOISE, IDAHO.—The United States supervising engineer F. E. Weymouth, announces that the construction of a 15,000 h.p. water plant is contemplated in this vicinity.

PLACERVILLE, CAL.—For the purpose of generating electricity H. C. Witman has filed on 12,000 miners' inches of the water of the American River at different points.

LIBBY. MONT.—The Milwaukee Electric Power Company has filed articles through J. H. Ehlers and will develop power on the Yank River in the western part of Lincoln county.

SAN FRANCISCO, CAL.—The Great Western Power Company has practically closed negotiations for the purchase of the City Electric Company. The Great Western has been represented in its dealings here by H. P. Wilson.

LOS ANGELES, CAL.—Sealed proposals will be received at the office of the United States Reclamation Service, Federal Building, Los Angeles, Cal., until March 10, 1911, for furnishing turbine water wheels for the Salt River Project, Arizona. For particulars address United States Reclamation Service, Federal Building, Los Angeles, Cal., or Washington, D. C.

RED BLUFF, CAL.—Fred T. Horton has filed a water notice claiming 10,000 inches of the flowing water of Mill Creek, for the purpose of generating electricity, and producing power. Mr. Horton is a resident of Berkeley and a brother of Frank E. Horton, president of the Sierra Electric Power Company. It is supposed that this filing was in the interest of this corporation.

EXCHEQUER, CAL.—Sidney Sprout, formerly the consulting engineer for the Merced Falls Gas & Electric Company, has examined the power house and plant of the Exchequer Lighting & Power Company for the purpose of reporting upon a new site for the new power plant that is to take the place of the one destroyed by the recent flood in Merced River canyon.

REDMOND, ORE.—It is understood that the Crook County Water, Light & Power Company, owners of the power site at Cline Falls, on the Deschutes River, four miles west of this city, is having plans made for the development of power at that point, and as soon as the plans are fully worked out, machinery will be installed and a transmission line run from the falls to this city. The company contemplates putting in machinery of sufficient capacity to generate enough power to supply all this section of the county with lights and power, and run a transmission line to Prineville, 20 miles from here, to supply that city also with light and power.

TRANSPORTATION.

CENTRALIA, WASH.—The Twin City Light & Traction Company will extend its Centralia line to a connection with the new line of the Grays Harbor & Puget Sound Railroad on North Tower avenue.

BURBANK, CAL.—F. A. Halabug has been awarded the franchise for an electric line on Fourth street, Burbank, which was ordered for sale by the Board of Supervisors on petition of Burbank residents.

NORTH YAKIMA, WASH.—Farmers of Naches and vicinity are urging the extension of the electric road of the Yakima Valley Transportation Company from Fruitvale to a point three miles beyond Naches City.

PORTLAND, ORE.—Bids have been received for clearing the right of way for the Mt. Hood Railway & Power Company's transmission line across the Sandy River Valley, and it is expected that work will soon commence.

SOUTH BEND, WASH.—President J. O. Crary of the Twin City Electric Company has accepted the street railway franchise recently granted by the city of South Bend for an electric car line through the streets and alleys of the city.

SAN BERNARDINO, CAL.—The gap in the trolley route between San Bernardino and Upland will be shortly closed by the Southern Pacific Railroad Company, and a through line will be built from Santa Ana and Colton, thus completing a loop.

HOOD RIVER, ORE.—Pres. J. E. Eccles of the Mt. Hood Railway, a new road now running from Hood River to Parkdale, says it will be extended 5 miles as far as London Powers ranch. Mr. Eccles and W. H. Ingles, the promoters, live in Ogden, Utah.

FRESNO, CAL.—The Supervisors have adopted a resolution calling for bids for certain franchises along the proposed route of the Fresno, Hanford and Summit Lake Railroad between this city and Kingsburg and Centerville, applied for by the Fresno-Hanford road.

SACRAMENTO, CAL.—Senator Finn's bill, which gives to San Francisco the right to build a municipal street railway over East street from the Presidio to Hunter's point, has passed in the Assembly without a dissenting vote and is now

ready to be sent to the Governor. The bill was amended before final passage merely to provide against the possibility of the city of San Francisco ever transferring the grant.

SAN JOSE, CAL.—Improvements on the First street railroad system, which includes all the branch lines of the road which are now being made, will be finished, it was estimated, within thirty days at a total cost of $400,000. The San Jose Railroad Company controls the lines. The system is being broad-gauged over ten miles of trackage and the newly renovated broad-gauge cars are being put into use as fast as the various sections of the road are finished. The paving contracts alone on the work will aggregate $200,000. The broad-gauging of this road means the eventual improvement of the line between this city and Alum Rock. This line covers seven miles and is now operated as a single-track, narrow-gauge road. It will be double-tracked and broad-gauged as soon as the First street work has been completed.

VALLEJO, CAL.—The Vallejo and Northern Railway Company, associated with the Northern Electric Railway Company, has made the first step toward changing its proposed route southward from Sacramento to the bay. This follows the action taken by the board of directors of the company at a meeting held at Suisun last week when it was decided to abandon the fight for a franchise in Vallejo and adopt the other route in preference to that along the Mare Island channel, where the company has already sunk $50,000 buying a tideland right of way. It is stated that citizens of Benicia have assured the railway company of a private right of way and terminal facilities upon deep water, shortening the route to San Francisco by over an hour. It was the original intention of the company to create its terminal in this city, building by way of Cordelia, Napa Junction and Vallejo.

ALAMEDA, CAL.—The first shipment of cars for the new Alameda electric system of the Southern Pacific Company reached the Oakland mole from the East last week and will be transferred to the car shops at the mole, to be given the finishing touches before being ready for service on the system which is to start operation this summer. The cars are all-steel coaches, about seventy feet long and will seat 116 passengers each. The seats are of rattan, arranged crossways, with an aisle between and at one side of the center of the cars. On one side the seats are the regulation two-passenger rattan seats, while on the other side of the aisle the seats are longer, accommodating three passengers each. The cars, as they come from the factory, are equipped with big, open platforms, which the Southern Pacific Company will vestibule, allowing two entrances at each end of each car, which will facilitate discharging passengers and taking on new passengers. Other shipments are promised at regular intervals without further delay, and the cars will be all on hand by the time the road is ready to operate. About thirty cars will be needed for the Alameda service alone.

OAKLAND, CAL.—A block system which will absolutely prevent rear-end collisions on the Key Route system has been installed and the trains are now running by the semaphore signals of this system, though official orders have not yet been issued the trainmen. Rear-end collisions are the only kind possible under the double-track system of this line. The block system is so arranged that a passing train automatically sets the signals for the trains following. As the train passes, the signal is set for "danger," and when the semaphore is in this position a trigger extends in such a manner that should another train attempt to pass, an air valve on the roof of the first car of the train violating rules would be thrown open, the air brakes set and the train brought to an immediate stop. When a train has passed a signal several hundred feet, the signal automatically drops to "caution," which requires the motorman to so run a following train that he can bring it to a quick stop without damage. When a train has passed far enough to make the line regarded as clear, the signal is automatically thrown to "safe" or "clear." If the apparatus should get out of order, the result would be to throw every signal on the line affected to "danger," and bring all trains to a stop.

TELEPHONE AND TELEGRAPH.

GRIDLEY, CAL.—The Home Telephone Company has applied for a franchise in this city.

MODESTO, CAL.—A. V. Faight is organizing a new telephone line. His company will begin construction work at once.

TOPPENISH, WASH.—The Yakima Valley Telephone Company will soon begin the installation of telephones in local business houses.

CHICO, CAL.—John Leeper has announced that arrangements for putting the Home telephone system in Chico in competition with the Bell lines are complete.

VALE, ORE.—Harry Abram, representing the Vale Independent Telephone Company, has applied for a franchise for the establishment of a telephone system here.

SAN FRANCISCO, CAL.—Beginning March 1 the W. U. Telegraph Company will inaugurate a day letter service similar to the night letter service instituted a year ago.

MERCED, CAL.—The petition of E. B. Thomas for permission to erect poles and construct a telephone line in the town of Livingston and along the county roads has been granted.

SAN FRANCISCO, CAL.—The annual report of the Pacific Telephone & Telegraph Company for the year ended Dec. 31, 1910, shows that, including the amount charged to operating expenses, but transferred to replacement reserves, the earnings for the common stock were equal to 11 per cent, as compared with 12.8 per cent for the previous year. The relatively smaller amount of earnings for the stock in 1910 than in 1909 was due in part to the increased interest charges. At the end of the year the total amount of replacement reserves was $4,190,566, as compared with $2,334,336 for the previous year, and with $190,250 at the end of the year 1908. The full amount of these replacement reserves has been charged against earnings in the last three years. The total amount is equal to 23.28 per cent on the $18,000,000 common stock, or at the rate of nearly 8 per cent per annum. It is thus seen that when the directors of the company decide that their replacement reserves have been accumulated to near the proper figure it will be an easy matter to begin the payment of dividends on the common stock. During the last few years the company's capitalization has been increased considerably, due to large expenditures for the rebuilding of the plant. The gross earnings, however, have more than kept pace with the increase in capitalization. In 1906 the percentage of gross earnings to capitalization amounted to 16.01 per cent, while in 1910 the percentage amounted to 20.44 per cent. In 1906 the capitalization per station amounted to $184, while by the end of 1910 the capitalization per station had been cut down to $160, notwithstanding the heavy increase in the amount of outstanding stock, bonds and notes.

WATERWORKS.

MADRAS, ORE.—Construction work on the new waterworks system for Madras has commenced. The work is in charge of Engineer Gordon who estimates the cost at $11,000.

KINGSBURG, CAL.—Sealed bids will be received by the Board of Trustees of the city of Kingsburg, Cal., up to 1 p. m., March 15, 1911, for furnishing any part or all of the material and labor required to construct a municipal water-works system in this city.